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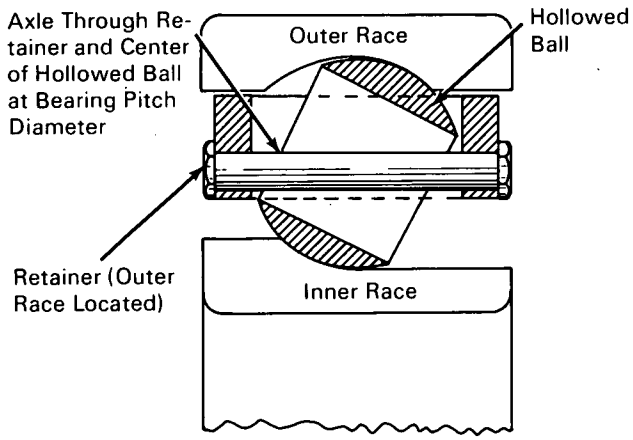
Brief 70-10468

NASA TECH BRIEF

"Drilled Ball" Bearings—An Approach to Extending Bearing Fatigue Life at High Speeds

Aircraft turbine engine rotor bearings currently operate at rotational speeds sufficiently high that bearing fatigue life governed by the high centrifugal forces developed between the rolling elements and the outer races is a significant factor. DN values (diameter of bearing bore in millimeters x shaft rpm) currently approach 2 million. It is estimated that aircraft engine designs in the next decade will require bearings to operate at DN values of 3 to 4 million. In this higher DN range, the predicted fatigue life of conventional rolling element bearings is so low that their use becomes impractical.



Section View of Test Bearing Showing Hollowed Ball and Mounting Detail

One approach to extending bearing fatigue life is to reduce the centrifugal forces between the rolling elements and the outer races by reducing the mass of the rolling elements. One method of reducing the mass of the rolling elements in ball bearings already under investigation is the use of hollow balls.

Ball mass can also be reduced by drilling a concentric hole through each ball (see fig.). Drilling the balls can reduce the mass by an amount equal to the mass reduction achieved by the use of thin-wall hollow balls. Additionally, the concentricity and finish of the drilled hole can be closely controlled and the balls accurately balanced.

The concept of "drilled ball" bearings was tested by modifying and running 75-mm bore, angular contact, ball bearings. A 10.7-mm diameter concentric hole was machined through the center of each 17.5-mm diameter ball, which reduced the ball weight by 50%. Each ball was mounted on a 3.1-mm diameter stainless steel tubing axle fastened to the bearing cage. The axles were located at the approximate center of each ball hole at the pitch diameter of the bearing. These bearings were operated at a 500-lb thrust load over a range of shaft speeds from 10,000 to 28,000 rpm (0.75 to 2.1-million DN), using either air-oil mist or oil jet lubrication. Outer race temperature and torque data obtained were compared with similar data for bearings with conventional solid balls and bearings with hollow balls which have 56% less weight than solid balls. Performance of the three types of bearings was closely comparable over the range of test speeds.

Notes:

1. The following documentation may be obtained from:

   Clearinghouse for Federal Scientific and Technical Information
   Springfield, Virginia 22151
   Single document price $3.00
   (or microfiche $0.65)

(continued overleaf)

Reference:
NASA-TM-X-52747 (N70-19336), Evaluation of Hollowed (Drilled) Balls in Ball Bearings at DN Values to 2 Million

2. Technical questions may be directed to:
Technology Utilization Officer
Lewis Research Center
21000 Brookpark Road
Cleveland, Ohio 44135
Reference: B70-10468

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

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